Predicting Responses of Arctic Plants to Warming with Species Distribution Maps

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Site Locations

Barrow *

Atqasuk *
Warming Treatment

↑1° - 3°C
Community Change  (Point Frame Method)
How does cover change?

In general, warming causes:

• Increase in cover
• Increase in height
• Increase in litter and standing dead
• Decrease in mosses and lichens

Even when a site does not respond as described above, there are increases and decreases in species within a growth form that cancel each other out.
Is geography a good predictor of community response to warming?
1. Cassiope tetragona (L.) D. Don
   Andromeda tetragona L.
   subsp. tetragona

   Coarse, dark-green dwarf shrub; leaves in 4 rows, lanceolate, deeply grooved
dorsally, puberulent, ciliolate; pedicels long, glabrous; calyx lobes reddish; corolla
bell-shaped.

   Dry heaths and rocks on tundra or in the mountains, to at least 2,000 meters.
Common in the North.
Latitudinal Distribution
Hultén 1968

Cassiope tetragona
(Group 2)

1: Southern limit north of 60°N
2: Southern limit between 60°N and 45°N
3: Southern limit between 45°N and 30°N
4: Southern limit between 30°N and 15°N
Latitudinal distribution

Cover (hits per plot)

northerly $\leftrightarrow$ southerly

$p < .10$
Results

This grouping scheme shows a trend at the Atqasuk wet site, but does not produce significant results and is not a good tool for predicting plant response to warming.

* *p<.05, ·p<.10
Longitudinal Distribution

*Hultén 1968*

*Cassiope tetragona*

(Group 1)

1: Present at all longitudes
2: Not present at all longitudes
Longitudinal distribution

Control
Warmed

*p<.05

Cover (hits per plot)

Present at all longitudes
Not present at all longitudes

* *p<.05
The Longitudinal Distribution group is only a useful predictor at the Barrow Dry site.
Alaskan Distribution
Hultén 1968
1: present throughout Alaska
2: present on north and south coasts
3: southern limit is north of southern coast
4: present in central AK, not at N or S coasts
5: northern limit is south of northern coast

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Alaskan Distribution
Hultén 1968

Carex aquatilis sub. Stans
(Group 3)
1: present throughout Alaska
2: present on north and south coasts
3: southern limit is north of southern coast
4: present in central AK, not at N or S coasts
5: northern limit is south of northern coast
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2: present on north and south coasts
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4: present in central AK, not at N or S coasts
5: northern limit is south of northern coast
Alaskan Distribution

Cover (hits per plot)

- Barrow Wet
- Barrow Dry
- Atqasuk Wet
- Atqasuk Dry

Control
Warmed

*p<.05

* p<.05
Alaskan Distribution

Cover (hits per plot)

* p < .05
Conclusions

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<th>Latitudinal Distribution</th>
<th>Longitudinal Distribution</th>
<th>Alaskan Distribution</th>
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<td>All Sites Combined</td>
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<tr>
<td>Atqasuk Dry</td>
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<td>Atqasuk Wet</td>
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<tr>
<td>Barrow Dry</td>
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<td>Barrow Wet</td>
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The Barrow Dry Site is the most responsive of the four sites.

The Alaskan Distribution group is the most useful for predicting response to warming.

The sites respond to warming differently and different grouping schemes will be useful for each.

*p<.05, ∙p<.10
Current and Future Questions

• Are there good predictors of community response to warming?
• Other geographic grouping schemes are being looked at to see if they agree with this investigation:
  – Young (1971)
  – Sørensen (1938)
• Other grouping schemes are being developed, based on
  – Morphology
  – Development
  – Phenology
References


Young, S.B., 1971,The vascular flora of St. Lawrence Island with special reference to floristic zonation in the Arctic regions: *Contributions of the Gray Herbarium*, v. 201, p. 11-115
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Thank you!